

Description

Field of the invention

The present invention relates to an apparatus and a system for generating vital information signals, particularly, to an apparatus and a system which can generate electric pulses that have specific digital coded sequence and minor energy. Such signals can be used to adjust and improve physiological functions of a living body for instance to fulfil medical and health care purposes.

Background of the invention

In recent years, based on the field theory, the information techniques and the theory of the traditional Chinese medicine, Chinese researchers have made extensive researches and a great deal of experiments on vital information, one of the most important vital characteristics of a living body. Particularly, by means of modern detecting equipments, measuring tests were made on "Fa Gong" or energy emitting phenomena of a "Qi Gong" expert or a deep breathing exercises expert, resulting in remarkable achievements. The present inventors made considerable efforts in this field, and their relevant research results were reported on "Nature Journal", Vol. 3, No. 8, August, 1980, pp. 563—566, published by Shanghai Science and Technology Publishing House, and "Science Yearbook", 1981, pp. 1.34—1.41, published by Shanghai Science and Technology Publishing House.

According to the theory of physics, the physical world manifests itself in two kinds of matter, one with static mass while the other with no static mass but energy (different kinds of field). These two kinds of matter are highly correlated and any one body with its static mass possesses its own natural resonance frequency. A living body can also be treated as a morphology system made up of cells, tissues and organs, as well as an information system made up of different kinds of field matter, such as cell's potential, electrocardiogram, electroencephalogram and different kinds of radiation. The two systems interact on each other and coexist within the same living body.

On the basis of the field theory and the information techniques, the present inventors made researches on the relations between the morphology system and the information system of a living body, and information exchange between the information system and the environment of the living body, so as to utilize the information of field matter to diagnose diseases and, by means of specific signals, to adjust the conditions of the information system of a living body, thus improving the conditions of the morphology system for medical and health care purposes.

In vital information science, researches have been made on the information exchange between a living body and its environment, particularly on the information exchange windows, which include:

information windows through which a living body can selectively receive and emit information signals, and which is represented by specific physical properties, frequency, waveform and strength of the information signals; and

address windows which is the capability of different positions on a living body for selectively receiving and emitting information signals, such as acupoints, blood vessels, lymphatic vessels and so on.

Since the vital information is related to the delicate structure of a living body, the vital information signals, different from those of the conventional physiotherapy, have a complicated waveform containing a large quantity of information therein. If the right windows on a living body are chosen, great biological activity will be produced by the vital information signals of minor energy and good curative effects to many diseases can be achieved, alternatively increased performance.

In prior art, there are some kinds of apparatus which can generate electric signals with certain waveform for medical or health care use, such as electric acupuncture apparatus, and cardiac pacemaker, etc. However, the quantity of the information contained in the signals generated by these kinds of apparatus is small since they work mainly by their own physical effects. However, the signals generated by the apparatus of the present invention contain a large quantity of information and minor energy, they have great biological activity and work through the information contained therein, thus making the present invention essentially different from the prior art.

US-A-4055190 describes an electrical therapeutic apparatus which is suitable for applying a pulse train to the human body. The pulse train generated by this apparatus consists of a series of bursts with a defined number of pulses in each burst. Between each burst there is a time period of no activity. The time period or number of pulses in each burst can be varied but the frequency remains the same. This frequency lies within the range 0.5 Khz to 1.6 Mhz. The bursts are applied to the patient every 1/2 to 10 seconds.

Summary of the invention

The present invention is an apparatus using modern electronic techniques for generating vital information signals, which generates a train of bursts which has an envelope in the form of pulse signals with specific frequency and duty cycle. Such vital information signals with special waveform and minor signal strength can be inputted through specific address windows into a living body to fulfill medical and health care purposes, or to increase performance.

The apparatus and system can generate vital information signals of different waveforms, the structure of which waveforms has the following features:

1. highly sequenced digital coded pulse train;

2. the pulse train or the bursts repeat periodically;

3. the specific structure of the waveform is highly correlated with certain physiological functions of a human or animal body, thus can be used for specific medical or health care purposes or to increase performance; and

4. each of the quantitative parameters of the pulse train (including coding structure, frequency, duty cycle, direct and alternating current components, etc.) should be selected from a strictly limited range, and beyond the allowable range, the signals will lose their original effects and sometimes can even be harmful.

A novel apparatus is provided by the present invention for generating pulse train with the above-mentioned features.

One object of the present invention is to provide a pulse train made up of a plurality of periodically repeated bursts. The specific waveform structure of the pulse train correlates with certain functions of the vital information system of a human or animal body; therefore, it can be used to adjust the vital information system, thus fulfilling specific medical or health purposes or increasing performance.

A further object of the present invention is to provide a system which can generate an electric pulse train with the above-mentioned wave train and input said pulse train into specific positions on a living body.

The objects of the present invention are solved by an apparatus for generating signals for application to a living body comprising:

a pulse generator means for generating a train of main pulses of constant width and spacing, a constant frequency in the range of 230—280 kHz, and a constant duty cycle in the range of 0.33—5.0, wherein each main pulse includes a plurality of secondary pulses; a signal output circuit; and at least one pair of output electrodes connected to the output circuit;

wherein the output circuit shapes and attenuates the main pulses, and the number of secondary pulses within a main pulse varies in some of the main pulses.

According to a first embodiment of the apparatus of the present invention, the apparatus comprises a main signal generating circuit, a secondary signal generating circuit, an output circuit and at least one pair of output electrodes.

According to a second embodiment of the apparatus of the present invention, the apparatus comprises a pulse generating circuit, a controlling circuit, an output circuit and its output electrodes.

According to a third embodiment of the apparatus of the present invention, the apparatus comprises a central processing unit (CPU), a clock circuit, a memory or an input interface, a pulse generator, an output circuit and its output electrodes.

According to a fourth embodiment of the apparatus of the present invention, the apparatus comprises a light source, a light-modulating device, a photosensitive device, a device for

driving the light-modulating device, an output circuit and its output electrodes.

The objects of the invention are also solved by a system for generating signals for application to a living body comprising:

an information recording medium;
a signal reproducing apparatus;
an interface circuit;
an output circuit; and
a pair of electrodes;

characterized in that:

the pulse train generated by the apparatus defined by any one of claims 1—12 is recorded on said information recording medium;

the pulse train recorded on said medium is reproducible by said reproducing apparatus which provides the reproducing pulse train to said output circuit via said interface circuit; and

said output circuit comprises an attenuating device which attenuates said reproduced pulse train in a frequency response range of 0—10 Mhz, then provides the attenuated pulse train via said electrodes to specific positions on a living body.

Brief description of the drawings

The above-mentioned features and objects of the present invention and other advantages and objects thereof will become more apparent in the following detailed description of the present invention in combination with the attached drawings, in which:

Fig. 1A—1E are illustrative diagrams showing the waveform analysis of the vital information signals generated by apparatus according to the present invention;

Fig. 2 is a block diagram showing the first embodiment of the apparatus according to the present invention;

Fig. 3 is a diagram showing a detailed circuit structure of the embodiment shown in Fig. 2;

Fig. 4 is a diagram showing the signal waveform on the corresponding nodes of the circuit shown in Fig. 3;

Fig. 5A—5C are block diagrams showing the second embodiment of the apparatus according to the present invention;

Fig. 6 is a diagram showing the signal waveform on the corresponding nodes shown in the block diagrams of Figs. 5A and 5B;

Fig. 7 is a block diagram showing the third embodiment of the apparatus according to the present invention;

Fig. 8 is a flow chart of the apparatus shown in Fig. 7;

Fig. 9A and 9B are illustrative diagrams showing the fourth embodiment of the apparatus according to the present invention;

Fig. 10 is an illustrative diagram showing another embodiment of the present invention;

Fig. 11 is an illustrative diagram showing another embodiment of the present invention; and

Fig. 12 is an illustrative diagram showing the output circuit of apparatus according to the present invention.

Detailed description of the invention

Figs. 1A—1E are diagrams showing waveform analysis of the vital information signals generated by apparatus of the present invention. For the convenience of analysing and understanding, the waveform characteristics of the signals are divided into the envelope characteristics and the characteristics of the bursts enclosed inside the envelope, both of them being in the form of digital pulses, thus the analysis can be done in a conventional approach for digital pulses. In the description hereinafter, the envelope is referred to as the main code of the vital information signals while the bursts enclosed therein are referred to as the sub-code of the vital information signals.

In Fig. 1A, the reference character n indicates the time sequence number of the vital information signals. In different vital information signals, different positive integer n can be selected as the time sequence number, i.e., one cycle of the signals is made up of n main code pulses. The practical values of n will be explained below. The reference character C indicates the time duration of one pulse period of the main code; F indicates the frequency of the main code, $F=1/C$; P indicates the pulse width of the main code; E indicates the distance between two main code pulses; and D indicates the duty cycle of the main code pulses, wherein $D=P/E$. In a group of waveforms of the vital information signals, the main code frequency F and the duty cycle D are constant with F ranging from 230 to 280 KHz and 250 KHz being preferable, and with D ranging from 0.33 to 5.0 and 1.67 being preferable.

Fig. 1B shows the sub-code structure with the main code waveform shown in Fig. 1A as the envelope. It can be seen in Fig. 1B that the sub-code pulses are kept within the width of the main code pulses, and within each main code pulse the leading edge of the first sub-code pulse substantially coincides with the leading edge of the main code pulse while the trailing edge of the last sub-code pulse substantially coincides with the trailing edge of the main code pulse. Reference characters N_1 — N_n indicate respectively the number of sub-code pulses enclosed in each of the main code pulse. It is shown in Fig. 1b that $N_1=3$, $N_2=6$, $N_n=8$. Within the same main code pulse, the pulse width p of each sub-code pulse, the distance e and the duty cycle d , wherein $d=p/e$, are all kept substantially constant. The duty cycle d can be selected from the range of 0.8—1.2 with 1.0 being preferable.

Fig. 1C shows an example of the vital information signals, in which $n=6$. The dash line shown therein represents the waveform of the main code which is not the actual output waveform but the envelope of the signals. The sub-code structures shown in Fig. 1C are $N_1=3$, $N_2=6$, $N_3=9$, $N_4=4$, $N_5=6$, $N_6=8$, $F=250$ KHz, $D=1.5$ and $d=1.0$. The waveform is repeated periodically in practical use.

Four kinds of waveform acceptable by the sub-code pulses are shown in Fig. 1D, in which (1) is

the square wave, (2) is the square wave with rounded corners, (3) is the integrated wave and (4) is the sine wave. In practical use, the square wave with rounded corners (2) is preferable.

Fig. 1E shows the relation between the magnitude of the vital information signals and time, in which V_d indicates the direct current component of the vital information signals and U_p indicates the peak-to-peak voltage of the sub-code pulses; both of them can be respectively selected from the ranges of

$$0 < V_d < 1.0 \text{ V and } 0 < U_p < 1.5 \text{ V.}$$

The sub-code pulses shown in Figs. 1B—1E are all positive pulses. If negative pulses are used instead, similar effects can also be achieved.

Several examples of the waveform of the vital information signals are shown in Tables 1—4 herebelow and their medical effects are explained.

Table 1

$n=6$, F : 230—280 KHz, D : 0.33—5.0; d : 0.8—1.2

N_1	N_2	N_3	N_4	N_5	N_6
3	6	9	4	6	8
4	6	9	3	6	8
3	4	6	6	8	9
3	8	9	4	6	6
4	8	9	3	6	6
3	4	9	6	6	8
3	4	8	6	6	9

Each pulse train indicated in Table 1 can be used to improve the circulatory functions of a human and animal body and to increase metabolism of the living tissue.

Table 2

$n=4$; F : 230—280 KHz, D : 0.33—5.0, d : 0.8—1.2

N_1	N_2	N_3	N_4
1	8	2	8

The pulse train indicated in Table 2 can be used for vision improvement or correction with quick effects.

Table 3

$n=2$, F : 230—280 KHz, D : 0.33—5.0, d : 0.8—1.2

N_1	N_2
2	8

The pulse train indicated in Table 3 can also be used for vision improvement or correction with long time effects.

Table 4
n=2, F: 230—280 KHz, D: 0.33—5.0, d: 0.8—1.2

N_1	N_2
8	9

The pulse train indicated in Table 4 can be used to adjust intestinal functions. It can be used to cure both constipation and diarrhoea.

Referring to Fig. 2, it shows a block diagram of the first embodiment of the apparatus according to the present invention. The reference numeral 100 indicates the apparatus as a whole; 101 indicates a main frequency generator which can be any conventional clock circuit with the frequency F of its output signal V_1 , being a constant value in the range of 230—280 KHz; 102 indicates a time sequence circuit which generates n parallel time sequence signals V_{21} — V_{2n} according to the time sequence number n of the desired vital information signals; 103 indicates a duty cycle control circuit which controls the duty cycle of the signals V_{21} — V_{2n} generated by the time sequence circuit 102 to keep its outputs V_{31} — V_{3n} within the required pulse width. A main code generating circuit is made up of the above-mentioned main frequency generator 101, time sequence circuit 102 and duty cycle control circuit 103. 104 indicates a group of sub-code generators which generate n parallel controlled sub-code signals V_{41} — V_{4n} according to the signals V_{31} — V_{3n} from the control circuit 103, wherein the pulse numbers of the sub-code signals are preset as $N_1, N_2, \dots, N_n$, respectively, and the duty cycle of the sub-code signals is preset as d. 105 indicates a composite circuit which combines the n parallel signals V_{41} — V_{4n} from the sub-code generator 104 into a highly sequenced serial signal V_5 with the desired waveform. The waveform of signals V_1 — V_5 is shown in Fig. 4, in which, as an example, $n=3$, $D=1.5$, $N_1=3$, $N_2=6$, $N_3=9$, $d=1.0$. 106 indicates an output circuit which divides, shapes and attenuates signal V_5 , then sends it out through the electrodes 10.

Fig. 3 is a diagram showing an example of the circuit of the embodiment shown in Fig. 2. In Fig. 3, the main frequency generator 101 comprises a crystal oscillator 1011 and a frequency divider 1012. The high frequency signal generated by the crystal oscillator 1011 is divided by frequency divider 1012 into a clock signal V_1 , as shown in Fig. 4. The time sequence circuit 102 comprises a shift register 1021 and a multi-input OR gate 1022. When the sequence number n of the vital information signal is 2, the time sequence circuit 102 can also be formed by a dual "D" Flip Flop. The shift register 1021, actuated by the input signal V_1 , sends out n parallel signals V_{21} — V_{2n} according to the desired value of n; the waveform of the signals is shown in Fig. 4. The time sequence circuit 102 can also be made of a ring counter or a counter/decoder. The duty cycle

control circuit 103 is made of monostable circuit which adjusts the width of the signals V_{21} — V_{2n} to form signals V_{31} — V_{3n} according to the desired D. The sub-code generator 104 comprises n parallel controllable oscillators 1041—104n, the frequency of each of the controllable oscillators 1041—104n being preset so that N_1 — N_n pulses can be sent out respectively within the pulse width of signals V_{31} — V_{3n} , as the signals V_{41} — V_{4n} shown in Fig. 4. In Fig. 4, $N_1=3$, $N_2=6$, $N_3=9$. The parallel output of the sub-code generator 104 is composited into a serial signal V_5 through the composite circuit 105 made of a multi-input OR gate. The output 106 comprises a multi-output circuit 1051 and a plurality of shaping and attenuating circuits 1062 which will be further explained hereinafter. In Fig. 3, there are also a frequency divider 107, a counter 108 and a display 109, which can count the number of sub-code pulses in the vital information signals sent out by the apparatus during a fixed period thus errors in the signals can be shown on display 109, when there is any. An alarm device can also be added to prevent errors in the signals. A selecting circuit 110 can be made of a selecting switch to select respectively corresponding signals sent out parallelly from circuit 1061 and to display the signal level on the display 111. In the circuit shown in Fig. 3, each waveform parameter of the output signal V_5 , such as F, D, N_1 — N_n , and d, can be determined by presetting the frequency F of the main frequency generator 101, the pulse width P of the duty cycle control circuit 103, the frequencies f_1 — f_n and the duty cycle d of the controllable oscillators and the duty cycle d of the controllable oscillators 1041—104n, so as to guarantee the correct code structure of the waveform.

Fig. 5A—5C are block diagrams of the second embodiment of the apparatus according to the present invention. In Fig. 5A, the reference numeral 200 indicates the apparatus as a whole; the main frequency generator 101, the time sequence circuit 102, the output circuit 106 and electrodes 10 are the same with those shown in Figs. 2 and 3, 201 indicates a coded pulse generating circuit and 202 indicates a code-controlling circuit. The coded pulse generating circuit 201 can be made of the practical circuits shown in Fig. 5B or 5C, which generates a burst with a predetermined frequency according to the input clock signal and control signals, while the code-controlling circuit 202 counts the pulse train sent out by the circuit 201. When the counting reaches a predetermined value, the code-controlling circuit 202 sends out a reset pulse which resets the coded pulse generating circuit 201 and the next burst with another specific frequency will be sent out after a predetermined time period. In this way, the coded pulse generating circuit 201, under the control of the circuit 202, generates a train of bursts, in which the frequency and the pulse number of each burst meet at the predetermined coding requirements, as shown by V_c in Fig. 6. The code-controlling

circuit 202 can be made of, for example, a presett-able counter, a programmable counter, a counter/pulse-distributor, or a counter-divider; etc.

Fig. 5B shows a circuit structure of the coded pulse generating circuit 201 which comprises a charging current switch 2011, a discharging current switch 2012, a capacitor 2013, a pulse generator 2014 and n parallel constant current sources 2015. The pulse generator 2014 can be made of a time base circuit, a phase locked loop frequency divider or a programmable frequency divider, etc. Under the control of the code-controlling circuit 202, the constant current sources 2015 charge the capacitor 2013 through the charging current switch 2011. When the potential of the capacitor 2013 reaches a predetermined value, the charging current switch 2011 is opened while the discharging current switch 2012 is closed so as to discharge the capacitor 2013. In this way, a sawtooth wave is generated, as shown in Fig. 6. The slope of the sawtooth wave can be changed by adjusting the current intensity of the constant current sources 2015, thus the width of the sawtooth wave is changed; therefore, the times of charging-discharging of the current within a determined period can be changed. The signal V_0 is inputted into the pulse generator 2014 to generate signal V_0 which is counted by the code-controlling circuit 202, and the pulse generator 2014 is reset according to the counted value so as to guarantee the desired distance between the bursts.

The code pulse generating circuit shown in Fig. 5B can be replaced by a programmable frequency divider, as shown in Fig. 5C. The programmable frequency divider divides properly a high frequency clock signal according to a routine to generate pulses with a desired frequency. Under the control of the programmable component, different signal parameters can be set to generate the vital information signals which meet different coding requirements.

It can be seen by comparing Fig. 6 with Figs. 1A—1E and Fig. 4 that signal V_d has the same structure with that of the main code shown in Fig. 1A. Its frequency F is determined by the main frequency generator 101 while its duty cycle D is determined by the coded pulse generating circuit 201 as well as the coding control circuit 202. V_c has the same structure with that of the pulse train of the vital information signals shown in Fig. 1c and V_s of Fig. 4, wherein the number of the sub-code pulses enclosed within the envelope of the main code pulses is counted by the code-controlling circuit 202 and the counted result is controlled according to preset values or a program.

The third embodiment of the apparatus according to the present invention is shown in Fig. 7 wherein the reference numeral 300 indicates the apparatus as a whole; 301 indicates a central processing unit CPU, 302 indicates a memory; 303 indicates an external input interface; 304 indicates a clock circuit which provides a timing signal for the system and works at a frequency of at least 30 MHz; 305 indicates a pulse generator,

which generates under the real time control of the CPU 301 pulse signals that are sent out by the output circuit 306 after being shaped and attenuated.

Fig. 8 shows a flow chart of the routine used in the apparatus 300. In this routine, step 100 inputs initial values into CPU 301, including the time sequence number n , number of cycles of the signal M , the duty cycle of the main code D , the duty cycle of the sub-code d , the number of sub-code pulses $N(i)$, the signal's output level U , the main code time period C , the main code pulse width P ($C=P+E$, $D=P/E$). The meaning of each parameter is the same with that shown in Figs. 1A—1E. Steps 101 and 102 are conventional setting steps. After judging by the judging step 103, the routine comes to calculating steps. In step 106, $P=DC/(1+D)$ is calculated and in step 107 the sub-code pulse width p is calculated by the equation

$$p=dP[N(i)(d+1)-1].$$

In step 109, a control signal is sent out according to the sub-code pulse width calculated, which signal makes the pulse generating circuit 305 generate a sub-code pulse with a pulse width p . After the cycling of steps 109—111, the pulse generating circuit 305 generates a right number of sub-code pulses, and then the routine comes to step 112, step 112 controls the pulse generating circuit 305, which sends out a null signal during the period E ($E=C-P$). After step 113, the routine returns to step 103 and starts calculating and sending out sub-code pulses of the next main code pulse. When $i=n$, a complete vital information signal has been sent out and the routine, controlled by step 105, repeats the output of the vital information signal according to a predetermined number M .

Figs. 9A and 9B show the fourth embodiment of the apparatus according to the present invention, in which the reference numeral 400 indicates the apparatus as a whole; 401 indicates a light modulating device; 402 indicates a light source which can be any conventional or laser light source; 403 indicates a photosensitive device such as a photosensitive diode or a photosensitive FET, etc, with its photoelectric response time being $T<10^{-8}$ S, dark current $I<10^{-8}$ A, and photoelectric sensitivity $S>100$ microampere/LX; 404 indicates a driving device, such as a high speed motor, which drives the light modulating device 401 to move relatively to the light source 402 and the photosensitive device 403; 405 indicates an amplifier circuit which amplifies the signal generated by the photosensitive device 403 and feeds it to the output circuit 106. A light modulating pattern formed on the light modulating device 401 has its width corresponding to the pulse waveform of the desired signal. As shown in Fig. 9B, when the light modulating device 401 driven by the driving device 404 moves relatively to the light source 402 and the photosensitive device 403, the light emitted from the light source 403 is modulated

into a light pulse train similar to the desired pulse train, and the photosensitive device 403 generates, corresponding to this light pulse train, an electric pulse train which can be sent out through the electrodes for medical and health care uses or to increase performance or through the amplifier 405 and the output circuit 106 to give it a proper level and then send it out multiply. This arrangement produces a very good waveform with very low noise and almost no waveform distortion all of which are important for the success and safety of the treatment. It is however possible to generate such pulses by purely electronic means however this is not the preferred embodiment. Obviously, the light-modulating device 402 can be changed from transmissive type shown in Fig. 9A into the reflective type and with corresponding rearrangement of the light source 402 and the photosensitive device 403, a similar result can be achieved. In this embodiment, the main code frequency, duty cycle and the sub-code frequencies can be adjusted by changing the rotary speed of the driving device 404, the radius of the light modulating device 401 and the distance between the slots thereon.

Referring to Fig. 10, an illustrative diagram of an embodiment of the present invention is shown, in which 501 indicates a signal output interface; 502 indicates a video signal reproducing apparatus, such as a video tape recorder, a laser disc player, etc; 503 indicates a video signal recording medium such as video tapes, laser discs, etc. the method includes the following steps:

1. recording the pulse train signals generated by any one of the embodiments of the apparatus according to the present invention on a video signal recording medium, such as a video tape or a laser disc, after proper adjusting of the level;

2. generating coded pulse train by using the above-mentioned recording medium and a signal reproduction apparatus as the signal source;

3. feeding the generated pulse train through the signal output interface 501 to the output circuit 106; and

4. sending out the signals shapes and attenuated by the output circuit 106 through electrodes 10 for medical or health care uses.

Referring to Fig. 11, there is shown an illustrative diagram of another embodiment of the present invention, in which 601 indicates an output interface; 602 indicates a computer which has a clock frequency of over 30 MHz; 603 indicates a memory medium for the program, such as a tape, a hard disc, a soft disc or the internal memory within the computer. The method includes the following steps:

1. programming the vital information signal according to the present invention into a routine by steps shown in the flow chart of Fig. 8;

2. generating the real time control signals by using computer 602 according to the waveform parameters inputted in the routine;

3. feeding the control signals through the interface 601 to the pulse generator 305 for generating desired coded pulse train signals;

4. shaping and attenuating the coded pulse train signals through the output circuit 106 and then sending out the signals for medical and health care uses.

Referring to Fig. 12, there is shown an illustrative diagram of the output circuit 106 of the present invention, in which 1061 indicates a level adjusting circuit, 1062 and 1063 are the signal attenuating device, V_i is the input of the circuit, $V_{o1}—V_{on}$ are the n parallel outputs. The level adjusting circuit 1061 can adjust the level of the input signal V_i in a relatively wide range (0—10 mHz) and shape its waveform then send it out through multiple outputs for the use of more than one patient. The signal attenuating devices 1062 and 1063 are resistive attenuating elements with their resistance being larger than 10^7 ohm and their frequency response range being between 0 to 10 MHz. The signal attenuating device can be made of biological materials, such as a piece of dried blood vessel or peritoneum after preservative treatment, so as to get the preferred output waveform.

The biological materials can be obtained from animals such as rat, rabbit, or chicken. A piece of the material should be treated by any conventional antiseptic agent under sterilized conditions then sealed by any conventional sealing agent in a sealing member such as a glass or plastic tube with two ends of the piece being kept direct contact with two electrodes which are led out of the sealing member. The piece of the biological material should be dried to keep the water contained therein less than 8 percent, preferably 4 percent. The length of the piece can be adjusted to obtain the desired resistance value. The prepared attenuating device should be of the inserting-type and should not be soldered under high temperature.

The output electrodes include a positive one and a negative one which can be made of any conductive material, but preferably a acupuncture needle or a thin copper sheet, the latter can be used as a non-invasive electrode to avoid pain caused by the needle. When the vital information signals are used for medical or health care purposes, the proper acupoints should be chosen as the address windows for information exchange according to patients' conditions. The blood vessel insertion of the needles can also be used, such as by introducing the positive electrode into an artery vessel of one arm and the negative electrode into a vein vessel of the opposite leg, so as to achieve better information exchange; however, to prevent harmful effects, the insertion of the electrodes should be avoided if the signals are not properly shaped and attenuated.

The apparatus for generating the vital information signals according to the present invention have been described hereinbefore, the above examples being used only for the convenience of explaining and understanding. For those skilled in the art, many amendments and modifications can be made to the above examples without departing from the scope of the present invention.

Claims

1. Apparatus for generating signals for application to a living body comprising:

a pulse generator means (100) for generating a train of main pulses of constant width and spacing, a constant frequency in the range of 230—280 kHz, and a constant duty cycle in the range of 0.33—5.0, wherein each main pulse includes a plurality of secondary pulses; a signal output circuit (106); and at least one pair of output electrodes (10) connected to the output circuit;

wherein the output circuit shapes and attenuates the main pulses, and the number of secondary pulses within a main pulse varies in some of the main pulses.

2. The apparatus for generating signals defined in claim 1, wherein said pulse generator means (100) is characterized by:

a main signal generating circuit, which comprises a main frequency generator (101), a duty cycle control circuit (103) and a time sequence circuit (102), and generates an envelope signal having said frequency and duty cycle;

a plurality of secondary signal generators (104), which generate sequentially a plurality of parallel bursts with desired frequencies and pulse numbers under the control of said time sequence circuit and said envelope signal; and

a composite circuit (105) which combines said parallel bursts generated by said secondary signal generators into a serial pulse train.

3. The apparatus for generating signals defined in claim 1, wherein said pulse generator means (100) is characterized by:

a pulse generating circuit (201);

a control circuit; and

main frequency generators (101);

wherein said pulse generating circuit (201) generates said pulse train under the control of said control circuit, which comprises a controlling circuit (202) and a time sequence circuit (102), said controlling circuit (202) and a time sequence circuit (102), said controlling circuit counts the output pulses provided by said pulse generating circuit and resets said circuit according to the counted number and a preset number therein, whereby the structure of the output signals is controlled.

4. The apparatus for generating signals defined in claim 1, wherein said pulse generator means is characterized by:

a central processing unit (301), which provides control signals for real time control of the generation of pulses according to initialized parameters and an inputted routine;

a memory (302), which stores said routine and parameters for controlling the generation of the pulse train;

an input interface circuit (303), through which the parameters and routine are inputted into said memory and CPU; and

a pulse generator (305) which generates said pulse train under the control of the CPU.

5. The apparatus for generating signals defined

in claim 1, wherein said pulse generator means is characterized by:

a light source (402);

a photosensitive device (403);

a light modulating device (401); and

a driving device (404);

a modulating pattern being formed on said light-modulating device corresponding to the waveform of the signals, whereby when said light-modulating device is driven to move at a certain speed relatively towards said light source and said photosensitive device, the light emitted from said light source is modulated into a light pulse train with a specific waveform which make said photosensitive device generate a corresponding electric pulse train.

6. The apparatus of claims 1 to 5, characterized by the parameter n of said pulse train indicating a sequence number of the main signals, d indicating a duty cycle of the secondary signals, N_i indicating a number of pulses within the main signal number i , $i:1-n$, a table of said parameters being as follows:

$n=6$ $d:0.8-1.2$

N_1	N_2	N_3	N_4	N_5	N_6
3	6	9	4	6	8
4	6	9	3	6	8
3	4	6	6	8	9
3	8	9	4	6	6
4	8	9	3	6	6
3	4	9	6	6	8
3	4	8	6	6	9

7. The apparatus of claims 1 to 5, characterized by the n of said pulse train indicating a sequence number of the main signals, d indicating a duty cycle of the secondary signals;

N_i indicating a number of pulses within the main signal number i , $i:1-n$, a table of said parameters being as follows:

$n=4$ $d:0.8-1.2$

N_1	N_2	N_3	N_4
1	8	2	8

8. The apparatus of claims 1 to 5, characterized by the n of said pulse train indicating a sequence number of the main signals, d indicating a duty cycle of the secondary signal, N_i indicating a number of the pulses within the main signal number i , $i:1-n$, a table of said parameters being as follows:



n=2 d: 0.8—1.2

N ₁	N ₂
2	8

9. The apparatus of claims 1 to 5, characterized by the n of said pulse train indicating a sequence number of the main signals, d indicating a duty cycle of the secondary signals, N₁ indicating a number of pulses within main signal number i, i:1—n, a table of said parameters being as follows.

n=2 d: 0.8—1.2

N ₁	N ₂
8	9

10. The apparatus of claims 1 to 5, characterized by said signal output circuit (106, 306) comprising a level adjusting circuit (106) and signal attenuating device (1062) which is connected between said level adjusting circuit and said electrodes (10) with its resistance being more than 10⁷ ohm and its frequency range being between 0—10 MHz.

11. The apparatus of claim 10, characterized by said signal attenuating device (1062) being a piece of biological tissue after preservative treatment.

12. The apparatus of claims 1 to 5, characterized by a counter (108) and a display (109), said counter counting the number of output pulses of said signals within a fixed time period to check if there is any error in the signals and to display its checking results on said display.

13. A system for generating signals for application to a living body comprising:

- an information recording medium (503, 603);
 - a signal reproducing apparatus (502, 602);
 - an interface circuit;
 - an output circuit; and
 - a pair of electrodes;
- characterized in that:

the pulse train generated by the apparatus defined by any one of Claims 1—12 is recorded on said information recording medium;

the pulse train recorded on said medium is reproducible by said signal reproducing apparatus which provides the reproduced pulse train to said output circuit via said interface circuit; and

said output circuit comprises an attenuating device which attenuates said reproduced pulse train in a frequency response range of 0—10 MHz, then provides the attenuated pulse train via said electrodes to specific positions on a living body.

14. The system as claimed in Claim 13, further characterized in that:

said information recording medium is a video signal recording medium; and

said signal reproducing apparatus is a video signal reproducing apparatus.

15. The system as claimed in Claim 13, further characterized in that:

said information recording medium is means for storing computer routines and data, and said signal reproducing apparatus is a computer and its output equipment.

Patentansprüche

1. Vorrichtung zur Erzeugung von Signalen zur Anregung an einen lebenden Körper gelöst, der folgende Einrichtungen aufweist:

—eine Impulsgebereinrichtung (100) zur Erzeugung einer Folge von Hauptimpulsen mit gleichbleibender Breite und konstantem Abstand, mit unveränderter Frequenz im Bereich zwischen 230 und 280 kHz, und mit einer konstanten Einschaltdauer von 0,33 bis 5,0, wobei jeder Hauptimpuls eine Vielzahl von Sekundärimpulsen enthält;

—sowie eine Signalausgangsschaltung (106) und

—mindestens ein Paar mit der Ausgangsschaltung verbundener Ausgangselektroden (10),

bei welcher die Ausgangsschaltung die Hauptimpulse formt und dämpft, während sich die Anzahl der Sekundärimpulse innerhalb eines Hauptimpulses bei einigen Hauptimpulsen verändert.

2. Vorrichtung zur Erzeugung von Signalen nach Anspruch 1, bei der die Impulsgebereinrichtung (100) gekennzeichnet ist durch:

—eine Generatorschaltung zur Erzeugung eines Hauptsignals, die einen Hauptfrequenzgeber (101), eine Einschaltdauer-Steuerschaltung (103) und eine Zeitfolgeschaltung (102) aufweist und ein Rahmensignal mit dieser Frequenz und dieser Einschaltdauer erzeugt;

—eine Vielzahl von Generatorschaltungen (104) zur Erzeugung von Sekundärsignalen, die unter Ansteuerung durch die Zeitfolgeschaltung und das Rahmensignal sequentiell eine Vielzahl von parallelen Impulsbündeln mit der jeweils gewünschten Frequenz und Impulsezahl erzeugen, und

—eine Verbundschaltung (105), die die von den Generatorschaltungen zur Erzeugung von Sekundärsignalen erzeugten parallelen Impulsbündel zu einer seriellen Impulsfolge zusammenführt.

3. Vorrichtung zur Erzeugung von Signalen nach Anspruch 1, bei der die Impulsgebereinrichtung (100) gekennzeichnet ist durch:

—eine Impulsgeberschaltung (201),

—eine Steuerschaltung, und

—Hauptfrequenzgeber (101),

wobei die Impulsgeberschaltung (201) unter Ansteuerung durch die Steuerschaltung die Impulsfolge erzeugt, wobei die Steuerschaltung eine Steuerschaltung (202) und eine Zeitfolge-



schaltung (102) aufweist, und wobei die Steuerung die von der Impulsgeberschaltung abgegebenen Ausgangsimpulse zählt und die Schaltung entsprechend dem Zählstand und einer darin voreingestellten Zahl rücksetzt, wodurch die Struktur der Ausgangssignale beeinflusst wird.

4. Vorrichtung zur Erzeugung von Signalen nach Anspruch 1, bei welcher die Impulsgebereinrichtung gekennzeichnet ist durch:

—eine Zentraleinheit (301), die Steuersignale zur Echtzeitsteuerung der Impulserzeugung unter Berücksichtigung der bei Initialisierung vorgegebenen Parameter und einer eingegebenen Routine liefert;

—einen Speicher (302), in dem die Routine und die Parameter zum Steuern der Impulsfolgeerzeugung abgespeichert sind;

—eine Eingangsschnittstellenschaltung (303), über welche die Parameter und die Routine in den Speicher und in die Zentraleinheit eingegeben werden, und

—einen Impulsgeber (305), der unter Steuerung durch die Zentraleinheit die Impulsfolge erzeugt.

5. Vorrichtung zur Erzeugung von Signalen nach Anspruch 1, bei welcher die Impulsbereinrichtung gekennzeichnet ist durch:

—eine Lichtquelle (402);

—ein lichtempfindliches Bauelement (403);

—eine Einrichtung (401) zur Lichtmodulation; und

—eine Antriebseinrichtung (404),

wobei in Entsprechung zu der Wellenform der Signale ein Modulationsmuster auf der Einrichtung zur Lichtmodulation gebildet wird, während bei Antrieb der Einrichtung zur Lichtmodulation zur relativen Bewegung in Richtung zur Lichtquelle und zu dem lichtempfindlichen Bauelement bei einer bestimmten Geschwindigkeit das von der Lichtquelle ausgesendete Licht zu einer Lichtimpulsfolge mit einer speziellen Wellenform moduliert wird, wodurch das lichtempfindliche Bauelement zur Erzeugung einer entsprechenden Folge elektrischer Impulse veranlaßt wird.

6. Vorrichtung nach den Ansprüchen 1 bis 5, gekennzeichnet durch den Parameter n der Impulsfolge als Angabe einer Folgenummer der Hauptsignale, wobei d eine Einschaltdauer der Sekundärsignale, und N_i eine Anzahl von Impulsen innerhalb der Anzahl i des Hauptsignals angibt und $i: 1-n$ ist, während eine Tabelle der Parameter folgendermaßen strukturiert ist:

$n=6, \quad d: 0,8-1,2$

N_1	N_2	N_3	N_4	N_5	N_6
3	6	9	4	6	8
4	6	9	3	6	8
3	4	6	6	8	9
3	8	9	4	6	6
4	8	9	3	6	6
3	4	9	6	6	8
3	4	8	6	6	9

7. Vorrichtung nach den Ansprüchen 1 bis 5, dadurch gekennzeichnet, daß n bei der Impulsfolge eine Folgenummer der Hauptsignale und d eine Einschaltdauer der Sekundärsignale bezeichnet, und N_i eine Anzahl von Impulsen innerhalb der Hauptsignalzahl i bei $i: 1-n$ angibt, wobei eine Tabelle der Parameter folgendermaßen strukturiert ist:

$n=4, \quad d: 0,8-1,2$

N_1	N_2	N_3	N_4
1	8	2	8

8. Vorrichtung nach den Ansprüchen 1 bis 5, dadurch gekennzeichnet, daß n bei der Impulsfolge eine Folgenummer der Hauptsignale und d eine Einschaltdauer der Sekundärsignale bezeichnet, während N_i eine Anzahl der Impulse innerhalb der Hauptsignalnummer i bei $i: 1-n$ bezeichnet, wobei eine Tabelle der Parameter folgendermaßen strukturiert ist:

$n=2, \quad d: 0,8-1,2$

N_1	N_2
2	8

9. Vorrichtung nach den Ansprüchen 1 bis 4, dadurch gekennzeichnet, daß n bei der Impulsfolge eine Folgenummer der Hauptsignale und d eine Einschaltdauer der Sekundärsignale bezeichnet, während N_i eine Anzahl der Impulse innerhalb der Hauptsignalnummer i bei $i: 1-n$ bezeichnet, wobei eine Tabelle der Parameter folgendermaßen strukturiert ist:

$n=2, \quad d: 0,8-1,2$

N_1	N_2
8	9

10. Vorrichtung nach den Ansprüchen 1 bis 5, dadurch gekennzeichnet, daß die Signalausgangsschaltung (106, 306) eine Pegelregelschaltung (106) und eine Signaldämpfeinrichtung (1062) aufweist, die zwischen die Pegelregelschaltung und die Elektroden (10) geschaltet ist, wobei der Widerstand über 10^7 Ohm und der Frequenzansprechbereich zwischen 0 und 10 MHz liegen.

11. Vorrichtung nach Anspruch 10, dadurch gekennzeichnet, daß die Signaldämpfeinrichtung (1062) ein Stück konservierend behandeltes biologisches Gewebe ist.

12. Vorrichtung nach den Ansprüchen 1 bis 5, gekennzeichnet durch einen Zähler (108) und eine Anzeige (109), wobei der Zähler zur Überprüfung der Signale auf Fehler die Anzahl der Ausgangsimpulse der Signale innerhalb eines bestimmten



Zeitintervalls zählt und die Anzeige der Ergebnisse der Überprüfung auf der Anzeige veranlaßt.

13. System zur Erzeugung von Signalen zur Zuführung zu einem lebenden Körper, welches die folgenden Einrichtungen aufweist:

—ein Medium zur Aufzeichnung von Information (503, 603);

—eine Schnittstellenschaltung;

—eine Ausgangsschaltung, und

—ein Paar Elektroden,

dadurch gekennzeichnet, daß

—die von der Vorrichtung nach einem der Ansprüche 1 bis 12 erzeugte Impulsfolge auf dem Medium zur Informationsaufzeichnung aufgezeichnet wird;

—daß die auf dem Medium aufgezeichnete Impulsfolge durch die Signalwiedergabevorrichtung reproduzierbar ist, die die wiedergegebene Impulsfolge über die Schnittstellenschaltung der Ausgangsschaltung zuleitet, und

—daß die Ausgangsschaltung eine Dämpfeinrichtung aufweist, welche die wiedergegebene Impulsfolge in einem Frequenzansprechbereich zwischen 0 und 10 MHz dämpft und anschließend die gedämpfte Impulsfolge über die Elektroden bestimmten Stellen auf einem lebenden Körper zuführt.

14. System nach Anspruch 13, weiterhin dadurch gekennzeichnet, daß:

—das Medium zur Informationsaufzeichnung ein Mittel zur Aufzeichnung von Bildsignalen ist, und

—daß die Vorrichtung zur Signalwiedergabe eine Abspielvorrichtung für Bildsignal ist.

15. System nach Anspruch 13, weiterhin dadurch gekennzeichnet, daß das Medium zur Informationsaufzeichnung eine Einrichtung zum Abspeichern von Rechner Routinen und Daten ist, und daß die Vorrichtung zur Signalwiedergabe ein Rechner mit seinen Ausgabeeinheiten ist.

Revendications

1. Appareil de production de signaux destinés à être appliqués à un corps vivant et comportant:

—des moyens générateurs d'impulsions (100) produisant un train d'impulsions principales de durée et d'écartement constants, d'une fréquence constante dans la plage de 230 à 280 kHz et un rapport cyclique constant dans la plage de 0,33 à 5,0, dans lequel chaque impulsion principale comporte plusieurs impulsions secondaires; un circuit de sortie de signaux (106), et au moins une paire d'électrodes de sortie (10) connectées au circuit de sortie;

—dans lequel le circuit de sortie met en forme et atténue les impulsions principales et le nombre des impulsions secondaire dans une impulsion principale varie dans certaines des impulsions principales.

2. Appareil de production de signaux selon la revendication 1, dans lequel lesdits moyens générateurs d'impulsions (100) sont caractérisés par:

—un circuit générateur de signaux principaux qui comporte un générateur de fréquence princi-

pale (101), un circuit de commande de rapport cyclique (103) et un circuit de séquence de temps (102) et produit un signal d'enveloppe ayant ladite fréquence et ledit rapport cyclique;

—plusieurs générateurs de signaux secondaires (104) qui produisent séquentiellement plusieurs rafales en parallèle avec les fréquences voulues et les nombres d'impulsions voulus sous la commande dudit circuit de séquence de temps et dudit signal d'enveloppe; et

—un circuit composite (105) qui combine lesdites rafales parallèles produites par lesdits générateurs de signaux secondaires en un train d'impulsions en série.

3. Appareil de production de signaux selon la revendication 1, dans lequel lesdits moyens générateurs d'impulsions (100) sont caractérisés par:

—un circuit générateur d'impulsions (201);

—un circuit de commande; et

—des générateurs de fréquence principale (101);

dans lequel ledit circuit générateur d'impulsions (201) produit ledit train d'impulsions en série sous la commande dudit circuit de commande, qui comporte un circuit commandant (202) et un circuit de séquence de temps (102), ledit circuit commandant (202) et un circuit de séquence de temps (102), ledit circuit commandant compte les impulsions de sortie produites par ledit circuit générateur d'impulsions et réinitialise ledit circuit en fonction du nombre compté et d'un nombre prédéterminé qu'il contient, grâce à quoi on commande la structure des signaux de sortie.

4. Appareil de production de signaux selon la revendication 1, dans lequel lesdits moyens générateurs d'impulsions sont caractérisés par:

—une unité centrale de traitement (301) qui produit des signaux de commande pour la commande en temps réel de la production d'impulsions en fonction de paramètres initialisés et d'une routine introduite;

—une mémoire (302) qui mémorise ladite routine et lesdits paramètres pour commander la production du train d'impulsions;

—un circuit d'interface d'entrée (303) par lequel les paramètres et la routine sont introduits dans ladite mémoire et la CPU; et

—un générateur d'impulsions (305) qui produit ledit train d'impulsions sous la commande de la CPU.

5. Appareil de production de signaux selon la revendication 1, dans lequel lesdits moyens générateurs d'impulsions sont caractérisés par:

—une source de lumière (402);

—un dispositif photosensible (403);

—un dispositif de modulation de lumière (401);

et

—un dispositif d'entraînement (404);

—une configuration de modulation étant formée sur ledit dispositif de modulation de lumière correspondant à la forme d'onde des signaux de manière que lorsque ledit dispositif de modulation de lumière est entraîné pour se déplacer à une certaine vitesse relative en direction de ladite



source lumineuse et dudit dispositif photosensible, la lumière émise par ladite source lumineuse soit modulée en un train d'impulsions lumineuses avec une forme d'onde spécifique par laquelle ledit dispositif photosensible produit un train d'impulsions électriques correspondantes.

6. Appareil selon l'une quelconque des revendications 1 à 5, caractérisé en ce que se le paramètre n de ladite série d'impulsions indique un nombre de séquences des signaux principaux, d indique un rapport cyclique des signaux secondaires, N_1 indique le nombre d'impulsions dans le nombre des signaux principaux, $i, i:1-n$, une table desdits paramètres est la suivante:

$n=6$ $d: 0,8-1,2$

N_1	N_2	N_3	N_4	N_5	N_6
3	6	9	4	6	8
4	6	9	3	6	8
3	4	6	6	8	9
3	8	9	4	6	6
4	8	9	3	6	6
3	4	9	6	6	8
3	4	8	6	6	9

7. Appareil selon les revendications 1 à 5, caractérisé en ce que si le nombre n dudit train d'impulsions indique un nombre de séquences des signaux principaux, d indique un rapport cyclique des signaux secondaires; N_1 indique un nombre des impulsions dans le nombre de signaux principaux $i, i:1-n$, une table desdits paramètres est la suivante:

$n=4$ $d: 8,8-1,2$

N_1	N_2	N_3	N_4
1	8	2	8

8. Appareil selon les revendications 1 à 5, caractérisé en ce que si le n dudit train d'impulsions indique un nombre de séquences des signaux principaux, d indique un rapport cyclique des signaux secondaires, N_1 indique le nombre des impulsions dans le nombre des signaux principaux $i, i:1-n$, la table desdits paramètres est la suivante:

$n=2$ $d: 0,8-1,2$

N_1	N_2
2	8

9. Appareil selon les revendications 1 à 5, caractérisé en ce que se le n dudit train d'impulsions indique un nombre de séquences des signaux principaux, d indique un rapport cyclique des signaux secondaires, N_1 indique le nombre

des impulsions dans ledit nombre de signaux principaux $i, i:1-n$, une table desdits paramètres est la suivante:

$n=2$ $d: 0,8-1,2$

N_1	N_2
8	9

10. Appareil selon les revendications 1 à 5, caractérisé en ce que ledit circuit de sortie de signaux (106, 306) comporte un circuit de réglage de niveau (106) et un dispositif d'atténuation de signaux (1062) connecté entre ledit circuit de réglage de niveau et lesdites électrodes (10), sa résistance étant supérieure à 10^7 ohms et sa plage de réponse en fréquence étant comprise entre 0 et 10 MHz.

11. Appareil selon la revendication 10, caractérisé en ce que ledit dispositif d'atténuation de signaux (1062) est un morceau d'un tissu biologique après un traitement de préservation.

12. Appareil selon les revendications 1 à 5, caractérisé en ce qu'il comporte un compteur (108) et un écran d'affichage (109),

ledit compteur comptant le nombre des impulsions de sortie desdits signaux dans une période de temps fixe pour contrôler s'il existe une erreur dans les signaux et pour afficher ses résultats de contrôle sur ledit écran d'affichage.

13. Système de production de signaux destinés à être appliqués à un corps vivant et comportant:

—un support d'enregistrement d'informations (503, 603);

—un appareil de reproduction de signaux (502, 602);

—un circuit d'interface;

—un circuit de sortie; et

—une paire d'électrodes;

caractérisé en ce que:

—le train d'impulsions produit par l'appareil défini selon l'une quelconque des revendications 1 à 12, est enregistré sur ledit support d'enregistrement d'informations;

—le train d'impulsions enregistrés sur ledit support est reproductible par ledit appareil de reproduction de signaux qui fournit le train d'impulsions reproduit audit circuit de sortie par l'intermédiaire dudit circuit d'interface; et

—ledit circuit de sortie comporte un dispositif d'atténuation qui atténue ledit train d'impulsions reproduit dans une plage de réponse en fréquence de 0 à 10 MHz, et fournit ainsi le train d'impulsions atténué à des positions spécifiques d'un corps vivant par l'intermédiaire desdites électrodes.

14. Système selon la revendication 13, caractérisé en outre en ce que:

—ledit support d'enregistrement d'informations est un support d'enregistrement de signaux vidéo; et

—ledit appareil de reproduction de signaux est un appareil de reproduction de signaux vidéo.



15. Système selon la revendication 13, caracté-
risé en outre en ce que:
—ledit support d'enregistrement d'informa-
tions est un moyen pour mémoriser routines de

calculateur et des données et ledit appareil de
reproduction de signaux est un calculateur et son
équipement de sortie.

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* C L M S *